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Research Report 1873

Positive Transfer of Adaptive Battlefield Thinking Skills

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U.S. Army Research Institute for the Behavioral and Social Sciences

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14. ABSTRACT *(Maximum 200 words)*:

Over the past decade the U.S. Army has identified an emerging need to train and develop leaders who are more adaptive and capable of responding effectively to a wide range of military operations. In response, the U.S. Army Research Institute for the Behavioral and Social Sciences has developed the Think Like a Commander (TLAC) training approach that utilizes the principles of deliberate practice to train Army officers in adaptive battlefield thinking. This research demonstrates that the training received in TLAC transfers to other tasks related to battle command, namely the production of a company level Operations Order (OPORD). Specifically, students enrolled in the Armor Captains Career Course who received TLAC training produced better OPORDs than students who did not receive TLAC training but who did engage in traditional tactical decision games. These results reinforce the continued use of TLAC in institutional, self-development, and unit training.

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Personnel Performance
and Training Technology

POSITIVE TRANSFER OF ADAPTIVE BATTLEFIELD THINKING SKILLS

EXECUTIVE SUMMARY

Research Requirement:

The ambiguous, changing nature of the contemporary operational environment and the Global War on Terrorism require the development of adaptive leaders. The Think Like a Commander (TLAC) training approach uses deliberate practice concepts to train a key component of adaptive thinking—how to quickly evaluate a rapidly changing tactical situation using expert behaviors. The training uses tactical vignettes to apply deliberate practice training concepts to battlefield thinking skills and allows officers to model their battlefield understandings, plans, visualizations and decisions after expert tacticians' thinking patterns. Previous research has demonstrated that TLAC does train adaptive thinking. The present research measured whether the training delivered in TLAC transfers to other tasks related to battle command. To do so, students in the Armor Captains Career Course (ACCC) who received TLAC training were compared to those who did not on how well they produced a company operations order (OPORD).

Procedure:

The effects of TLAC training upon the ability to produce a five paragraph company OPORD were examined. A sample of 95 First Lieutenants and Captains enrolled in ACCC either underwent TLAC training ($n = 16$) or did not ($n = 79$). To assess group equivalence, performance on written tests administered prior to TLAC training was compared.

Findings:

Students who received TLAC training performed significantly better on all five of the OPORD paragraphs produced than the students who did not receive TLAC training but who did engage in traditional tactical decision games. When restricting the analyses to those students with the same instructor, the same pattern held for all paragraphs except paragraph 3, wherein TLAC student performance was numerically, albeit not statistically, superior to the non-TLAC student performance. Analysis of the pre-TLAC measures revealed no significant differences between the TLAC and non-TLAC students.

Utilization and Dissemination of Findings:

The research demonstrates that TLAC trains adaptive thinking that transfers to the important battle command skill of preparing an OPORD. Further, it demonstrates that TLAC training adds to traditional institutional instruction. The research supports the use of TLAC as a valuable tool for training adaptive thinking. The results were briefed to Deputy Chief of Staff for Operations and Training, Training and Doctrine Command and to representatives of the U.S. Army Armor School, 16th Cavalry Regiment, and Army Training Support Center.

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POSITIVE TRANSFER OF ADAPTIVE BATTLEFIELD THINKING SKILLS

Introduction

Given a trend toward more cognitively complex jobs with ever-increasing responsibility assigned to individuals, traditional strategies for training cognitive skills are insufficient. Rather than simply training each individual how to perform specific tasks for which they are responsible it has become necessary to train individuals how to be more adaptable—to competently perform a number of varying tasks (Smith, Ford, & Kozlowski, 1997). The contemporary operational environment (COE) is viewed by the U.S. Army to be unstable and unpredictable. In order to deal with this type of volatile environment the Army has developed four interrelated strategies. One of these strategies is to train and equip Soldiers to become better warriors and more adaptive leaders (Harvey & Schoomaker, 2006). In addition to the need to develop such training, there is a corresponding need to gain evidence for the effectiveness of that training. Indeed, Brown (2000) has stated, "Reinstitution of evaluation of tactical proficiency is arguably the single most important action to be taken to improve the quality of tactical leaders today" (p. III-7).

To assist in meeting those needs, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) established a number of research and development efforts to investigate innovative methods, techniques, and tools to train and develop adaptive performance. One of those is the Think Like a Commander (TLAC) program. The TLAC training is unique because it uses a deliberate practice methodology with expert coaching to train leaders on a cognitive behavior—thinking—using methods that have traditionally been applied to training more observable and measurable behaviors (e.g., rifle marksmanship, tank gunnery, and sports performance). In short, TLAC does not greatly respect a traditional distinction between such things as physical movements, perceptions, and cognitions when it comes to training, rather it treats these all as behaviors that are amenable to the same training methods and principles. This paper will examine the training transfers of the TLAC training program.

Adaptive Thinking

The cognitive behavior to which our research effort has been applied is what has come to be called adaptive thinking by the U.S. Army. The term adaptive thinking describes the cognitive behavior of an individual who is confronted by unanticipated circumstances during the execution of a planned military operation (Lussier, Ross, & Mays, 2000). Adaptive thinking has been further defined as the ability to respond effectively to rapidly changing situations (Shadrick, Lussier, & Fultz, 2007). The skillful commander will, when performing adaptively, make adjustments within the context of the plan to either exploit the advantage or minimize the harm of the unanticipated event. In short, he will adapt to the existing conditions in order to increase the probability for success. That description of the adaptive thinking task defines the behavior in terms of the problem to be solved—to monitor the unfolding tactical situation for unanticipated events and to determine the proper actions in response to them. Another important aspect of adaptive thinking involves the conditions under which it must be performed. The thinking that underlies battlefield decisions does not occur in isolation or in a calm reflective environment, it occurs in a very challenging and dynamic environment. Commanders must think while performing: assessing the situation, scanning for new information, dealing with individuals

under stress, monitoring progress of multiple activities of a complex plan. Multitudes of events compete for their attention. Commanders who do not allocate many cognitive resources to adaptive thinking will still likely feel themselves very busy; commanders who do allocate resources to adaptive thinking will need to find ways to free those resources.

Knowledge of the domain area is clearly an important requisite for performing adaptive thinking well, but it is not sufficient. Typically U.S. Army officers after years of study, both in the classroom and on their own, develop a good conceptual understanding of the elements of tactical decision-making. However, that knowledge alone, no matter how extensive, does not guarantee good adaptive thinking. Thinking is an active process; it is a behavior one does with his or her knowledge. As an example, if officers are told that the enemy has performed various actions on the battlefield and they are asked to infer the enemy's intent, they can generally do this fairly well depending on their understanding of the tactical domain. They have both the knowledge and the reasoning ability to solve the problem. Despite that, the same officers when placed in a demanding environment and required to perform as commanders will not necessarily display the behavior, i.e., develop a model of a thinking enemy and update that model based on continuing assessment of enemy actions. Expert adaptive thinking under stressful performance conditions requires considerable training and extensive practice in realistic tactical situations until thinking processes becomes largely automatic.

The Think Like a Commander Themes

Deliberate practice is the cornerstone for developing expertise. A main tenet of the deliberate practice framework is that expert performance reflects extended periods of intense training and preparation (Ericsson, Krampe, & Tesch-Roemer, 1993). Describing the structure of deliberate practice activities, Ericsson et al. writes:

> ...subjects ideally should be given explicit instructions about the best method and be supervised by a teacher to allow individualized diagnosis of errors, informative feedback, and remedial training.... Deliberate practice is a highly structured aim; the specific goal of which is to improve performance. Specific tasks are invented to overcome weaknesses, and performance is carefully monitored to provide cues for ways to improve it further (pp. 367-8)

Repetitive performance causes behavior to become automatic. It is important that the behaviors that become ingrained conform to those of an expert—that they are the right behaviors. It is a well-known phenomenon that novices, through play alone, will improve rapidly for a short time but then may continue performing for decades without further improvement (e.g., Ericsson et al., 1993). Practice alone does not make perfect; it must be structured to ensure that performance, in this case thinking, is done in a correct manner. In order to accomplish training using a deliberate practice method the student must perform selected task elements and strive to conform his or her performance to some model of "correct form" or "expert form." If those desired elements of form have not been clearly identified, then the training will resemble the discovery learning of "train as you fight" more than it does deliberate practice. A critical component in the construction of the TLAC training for tactical adaptive thinking—an explicit set of eight expert tactical thinking behaviors - was formulated based on

ARI interviews and research with acknowledged tactical experts (Deckert, Entin, Entin, MacMillan, & Serfaty, 1994; Lussier, 1998; Ross & Lussier, 2000). These eight behaviors are termed "themes" of the training and are referred to as the Themes of Battlefield Thinking. Below is a list of the TLAC themes and a brief description of each:

- *Keep a Focus on the Mission and Higher's Intent*: Commanders must never lose sight of the purpose and results they are directed to achieve — even when unusual and critical events may draw them in a different direction.

- *Model a Thinking Enemy*: Commanders must not forget that the adversaries are reasoning human beings intent on defeating them. It's tempting to simplify the battlefield by treating the enemy as static or simply reactive.

- *Consider Effects of Terrain:* Commanders must not lose sight of the operational effects of the terrain on which they must fight. Every combination of terrain and weather has a significant effect on what can and should be done to accomplish the mission.

- *Use All Assets Available:* Commanders must not lose sight of the synergistic effects of fighting their command as a combined arms team. They consider not only assets under their command, but also those which higher headquarters might bring to bear to assist them.

- *Consider Timing*: Commanders must not lose sight of the time they have available to get things done. Experts have a good sense of how much time it takes to accomplish various battlefield tasks. The proper use of that sense is a vital combat multiplier.

- *See the Big Picture*: Commanders must remain aware of what is happening around them, how it might affect their operations, and how they can affect others' operations. A narrow focus on your own fight can get you or your higher headquarters blind-sided.

- *Visualize the Battlefield*: Commanders must be able to visualize a fluid and dynamic battlefield with some accuracy and use the visualization to their advantage. A commander who develops this difficult skill can reason proactively like no other. "Seeing the battlefield" allows the commander to anticipate and adapt quickly to changing situations.

- *Consider Contingencies and Remain Flexible*: Commanders must never lose sight of the old maxim that "no plan survives the first shot." Flexible plans and well thought out contingencies result in rapid, effective responses under fire.

The TLAC Training Approach

The TLAC uses deliberate practice concepts to train a key component of adaptive thinking — how to quickly evaluate a rapidly changing tactical situation using the expert themes described above. The TLAC uses cognitive battle drills to apply deliberate practice training concepts to battlefield thinking skills and allows officers to model their battlefield

understandings, plans, visualizations and decisions after expert tacticians' thinking patterns. The cognitive battle drills are represented in a set of vignettes based on tactical situations drawn from a single overarching scenario. Each vignette is a short, complex situation—typically two to four minutes in duration—that is presented in an audio-video file.

Each vignette has a unique set of 16-24 "indicators" that represent important considerations of expert battlefield commanders. These are the elements of the situation—the key features—that should play a role in the decision maker's thinking. With the assistance of senior military experts, the set of indicators was reduced to 16 for each vignette. While the themes are consistent across all vignettes, each vignette has unique indicators that represent what an expert commander should consider in that specific vignette situation if he or she were to engage in the thinking behavior represented by a particular theme. For a more in-depth discussion of TLAC, see Lussier, Shadrick, and Prevou (2003).

Once the presentation is completed, the student is asked to think about the situation presented and to list items that should be considered before making a decision. Over the course of the training, the amount of time students are allowed to respond to vignettes is decreased, forcing students to adapt to increased time pressure. After each student completes his or her list, an instructor leads a class discussion. Class members discuss the second- and third-order effects related to actions students suggest. Students are encouraged or required to discuss and/or defend considerations relevant to the vignette. Such coaching by a subject matter expert is a key part of the learning process to enable the student to develop expert habits.

In the final phase of each vignette, the students see the list of considerations that experts believed were important, along with the list they initially made, and they mark the indicators they have in common with the experts. Students are also asked to make the same evaluation on the class as a whole, based on classroom discussion. The purpose of the dual evaluations is to allow the student to get a true representation of their individual performance. For example, a student may only get fifty percent of the experts' important considerations for a given vignette. During the class discussion, however, 90 to 100% of the key considerations may be discussed. Students may inappropriately believe that their performance was directly linked to the performance of the class as a whole. Once the students rate their performances, they are given feedback on the screen linked to the general themes, (e.g., 25% of expert considerations for the 'Model a Thinking Enemy' theme). This individual feedback supplements and complements the feedback given by the instructor during the class discussion phase of the training. The students are then able to focus their future thinking on subsequent vignettes and place additional attention on themes for which they scored low.

Prior Implementation and Evaluation of the TLAC Training Program

The TLAC training program has been used during classroom (face-to-face) training in the Armor Captains Career Course at Fort Knox. The training has also been provided via synchronous distance learning to officers in the Reserve Component–Armor Captains Career Course at Fort Knox with students deployed to Bosnia, Afghanistan, and Iraq—as well as other locations. In addition, the training has been used or demonstrated at Fort Leavenworth, Fort Sill, Fort Lee, Fort Eustis, Fort Huachuca, Fort Benning, Fort Leonard Wood, and the Joint Forces Headquarters of the Indiana National Guard. The training has been used for schoolhouse, unit,

and pre-deployment training. An instructorless version of the training ("Captains in Command") has also been developed. Captains in Command utilizes 3-D animated coaches who discuss the vignettes from the perspective of an expert decision-maker and prompt students to make their responses.

Shadrick and Lussier (2004) showed that use of the *Think Like a Commander* training program improved adaptive thinking. An examination of student self-scores revealed significant performance gains in a key component of adaptive thinking: the rapid analysis of battlefield situations to identify key considerations for decision-making (see Figure 1). Student scores were verified by an independent rater to insure scores were not systematically inflated. The performance gains were found even though response time was steadily decreased. Initially, students were provided 15 minutes to respond to the vignettes. As students progressed through the training the amount of response time was ultimately reduced to 3 minutes. The percent of critical information identified continued to rise even though response time was steadily decreased.

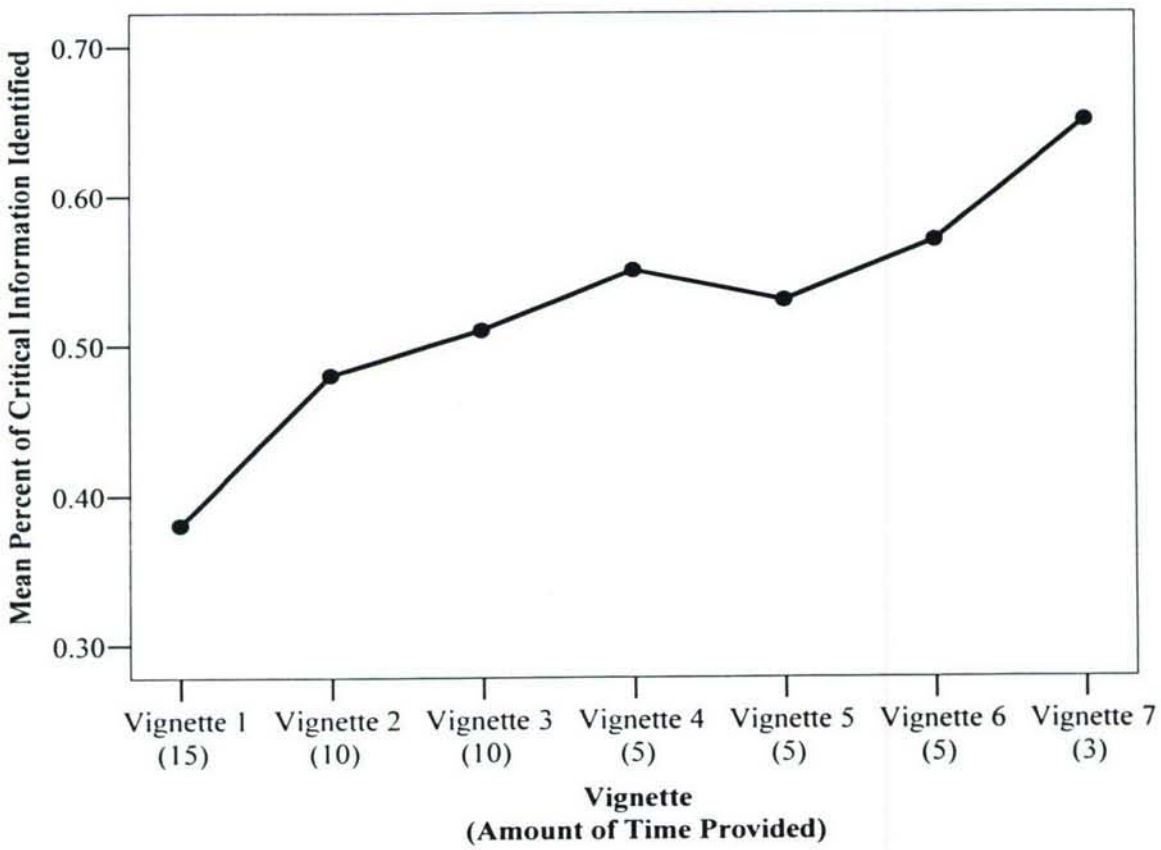

Figure 1. Proportion of indicators identified by vignette (from Shadrick & Lussier, 2004)

After the success of the TLAC training in the resident course (Shadrick & Lussier, 2004), the training was provided via a synchronous collaborative tool to captains in the U.S. Army Reserve and National Guard, many of whom were currently deployed to Iraq or Afghanistan. Both students and instructors perceived the training as being valuable (Gossman, Heiden, Flynn,

Smith, & Shadrick, in preparation). Specific feedback from deployed leaders collected as a part of the Reserve Component–ACCC at Fort Knox indicated that the TLAC training is a useful and important training and learning tool. Many wish they would have had access to the training prior to their deployments to Iraq or Bosnia. Others indicated that it prepared them for events they face on a daily basis. The significant performance gains and the feedback obtained from deployed leaders led Shadrick, Lussier, and Fultz (2007) to investigate whether leaders deployed to Iraq and Afghanistan would perform better on TLAC exercise then those individuals without such deployment experience. For non-Operation Iraqi Freedom (OIF)/Operation Enduring Freedom (OEF) officers, the results clearly demonstrated a direct relationship between the level of experience and the amount of critical information identified (see Figure 2). Scores for non-OIF/OEF officers increase as the level of rank (or experience) increases. Those results clearly indicate that there is a relationship between rank and performance levels when measured with TLAC vignettes. On the other hand, results for those officers with OIF/OEF deployments were not as clear. For those officers, there was a convergence of scores for captains, majors, and lieutenant colonels. The result is consistent with the assertion that captains in Iraq and Afghanistan are being forced to become more adaptive (e.g., Wong, 2004). The fact that a deployment to OIF/OEF, and the experience gained during that deployment, did change performance adds additional support for the validity of the training and the measures. Thus, the results clearly indicate that the TLAC training does train adaptive thinking skills.

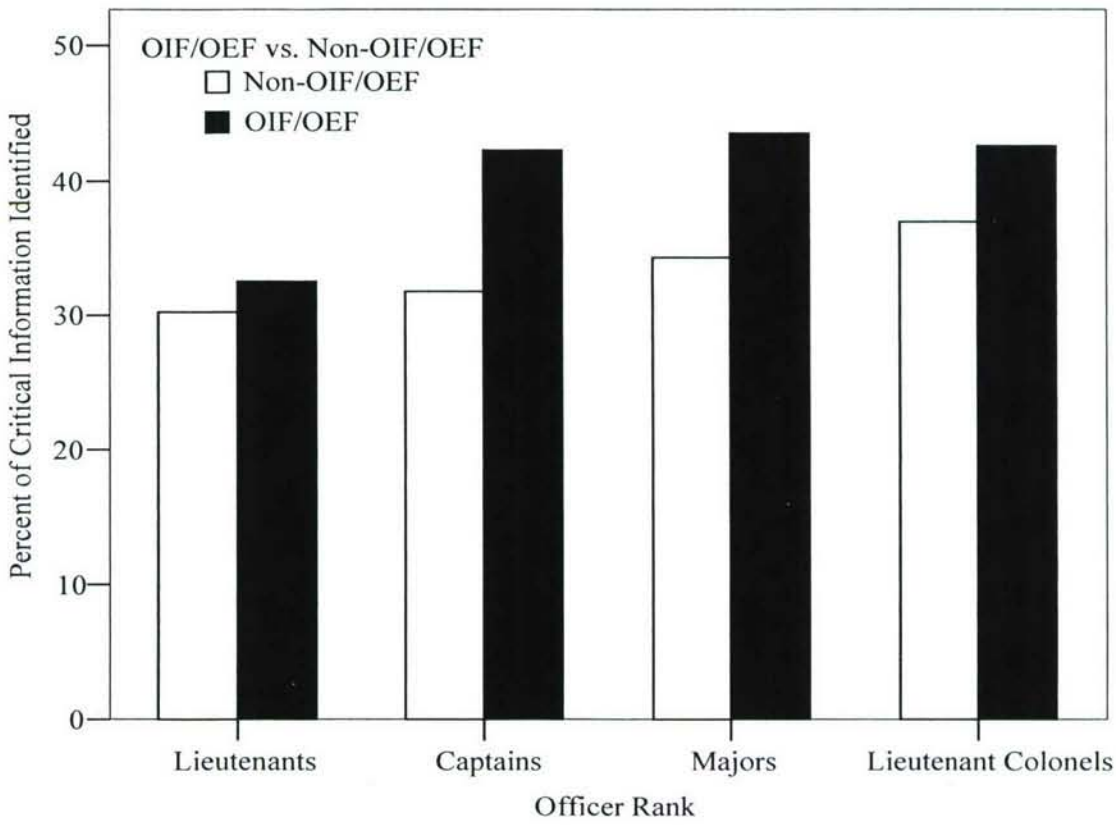

Figure 2. Percent of indicators identified by rank and training vs. deployed learning (from Shadrick et al., 2007).

Transfer of Training

The TLAC training has demonstrated the ability to train the underlying structures or themes used by experts to deal with vignettes representative of the COE. Furthermore it has been shown that the TLAC training does train adaptive thinking skills. What is still unknown is whether or not the TLAC training can transfer to tasks outside of the TLAC training environment. Transfer of training can be defined as the degree to which trainees effectively apply the skills, knowledge, and/or attitudes gained in a training context to a new context (Baldwin & Ford, 1988). Transfer occurs when an individual applies previously learned knowledge to solve a novel problem. Gick and Holyoak (1987) identify three types of transfer; 1) *self-transfer* where prior knowledge is used in a mere repetition of the training problem, 2) *near transfer* where prior knowledge is used to solve a problem that is highly similar to the training problem(s), and 3) *far transfer* where prior knowledge is used to solve a problem that is highly dissimilar to the training problem(s).

The concept of similarity can also be further decomposed into *surface* and *structural* similarities. *Surface* similarities or differences between a training problem and a transfer problem are functionally unrelated to the solution, whereas *structural* similarities or differences are functionally and/or causally linked to the solution. For example, if a Soldier was trained to disassemble one M-16, changing the color of the M-16 would be a change in *surface* similarity, whereas changing the kind of weapon would be a change in *structural* similarity. Both structural and surface similarities have an impact on the individual's subjective appraisal of the objective degree of similarity between two tasks (Gick & Holyoak, 1987).

The current research attempted to determine if TLAC demonstrates transfer of training by investigating how TLAC training affected students' performance in the ACCC. Specifically, we compared the performance of students who received TLAC training with those who did not in the preparation of a company-level Operation Order (OPORD). That can be considered a *far* transfer task with relatively *low* surface similarity to the responses to the vignettes in TLAC. Although both the training in TLAC and the task of writing an OPORD deal with military command and tactical decision-making, and so are relatively high in *structural* similarity, they are different in a number of ways. First, the vignettes in TLAC model dynamic situations that occur during the execution of a mission, while the production of an OPORD occurs during mission planning. Second, TLAC requires adaptive decision-making, while the decision-making involved in producing an OPORD is more deliberative in nature. Third, the responses made during TLAC are free-form in nature, while the producing of an OPORD is highly structured and formatted (DA, 2005).

It needs to be stressed that at the company level the drafting of an OPORD is not a one-stage process. Rather, it is the outcome of the application of the multi-staged troop leading procedures (TLP). "Troop leading procedures is a dynamic process used by small unit leaders to analyze a mission, develop a plan, and prepare for an operation" (DA, 2005, p. 4-1). The planning steps in the TLP reflect, but do not duplicate, those in the military decision-making process (MDMP) (FM 5-0). Figure 3 provides an overview of TLP, including the steps of mission analysis, course of action (COA) development, analysis, comparison, and selection.

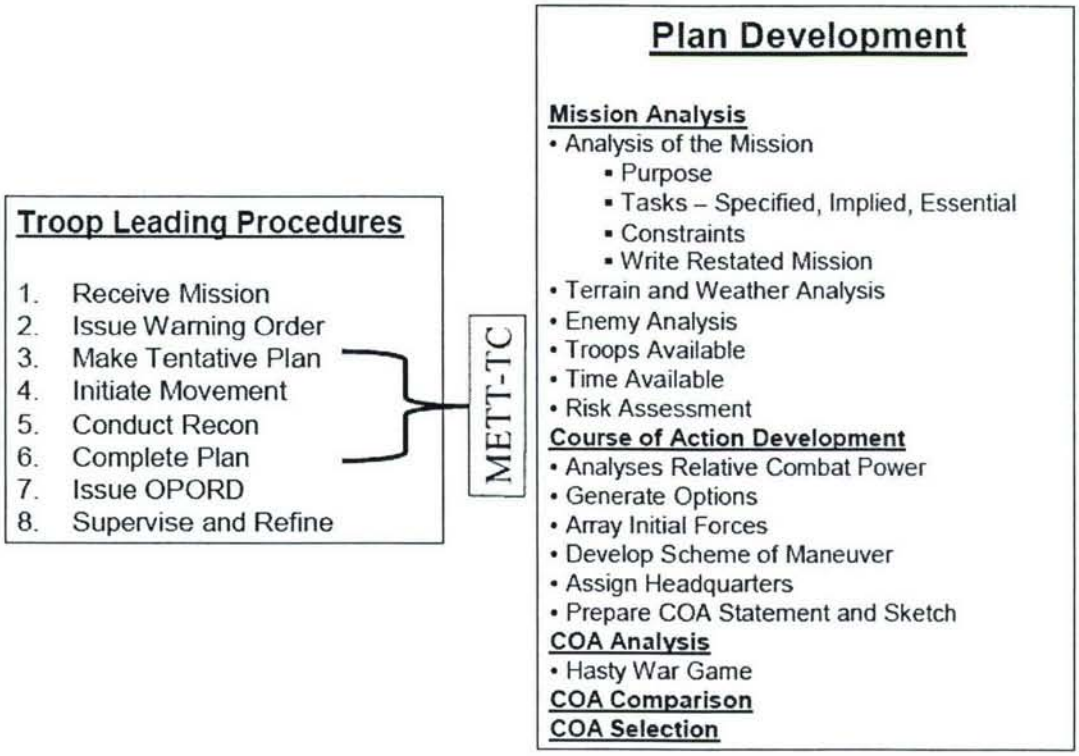

Figure 3. Planning at company and below (from FM 5.0).

For an OPORD to be effective, the decision-maker must possess an accurate and adequate mental model of the area of operations (AO). The TLAC training is designed to train Soldiers to quickly and automatically develop such mental models (i.e., 'size up a situation') so that further actions taken (such as producing an OPORD) will have a firm basis. Soldiers are to use the themes of Mission, Enemy, Terrain, Troops, Time, and Civil considerations (METT-TC) as mental guides when planning and producing an OPORD. The Themes of Battlefield Thinking in TLAC training serve a very similar role and overlap in many ways (e.g., *Model a Thinking Enemy* in TLAC is equivalent to *Enemy* considerations in METT-TC). Further, the construction of an OPORD is often undertaken when working memory load is high (DA, 2005). Therefore, training Soldiers to be able to automatically size up a situation also reduces demands upon the cognitive system, thus freeing up resources for the construction of an OPORD. Finally, because the enemy is a thinking and adaptive foe, failure to expeditiously complete an OPORD may yield initiative to the enemy (DA, 2005).

Laboratory research has shown that transferring knowledge from one context to a new context can be very difficult, particularly for far transfer with low surface similarity (e.g., Gick & Holyoak, 1980). However, there are at least three characteristics of TLAC that suggest it could lead to successful transfer. First, rather than train students how to perform a specific mission or task, TLAC provides a set of themes that are thought to apply to a wide range of tactical decision-making situations. A number of studies have shown that the explicit training of abstract principles (sometimes called *high* road transfer) can lead to successful transfer (e.g., Gick & Holyoak, 1983; Salomon & Perkins, 1987, 1989). Second, the themes in TLAC constitute a mental model for processing and organizing the information in a tactical situation (Ross,

Battaglia, Hutton, & Crandall, 2003; Phillips, Shafer, Ross, Cox, & Shadrick, 2005). The training of a mental model and guidance in how to apply it have been shown to improve transfer of training (e.g., Rouse & Morris, 1986). Third, the vignettes cover a wide variety of tactical situations. There is evidence that using a variety of examples increases likelihood of transfer (see Gick & Holyoak, 1987 for a discussion). For these reasons, it was predicted that students who received TLAC training would produce better OPORDs than students who did not receive TLAC training but who did engage in traditional tactical decision games (TDGs).

Method

Participants

The performance of 118 students enrolled in ACCC at Fort Knox, KY, was collected. The ACCC is conducted in groups of no more than 12 students led by a small group instructor (SGI). The students in this research effort were members of 11 different small groups enrolled in ACCC during the 2005 to 2006 timeframe as the course was transitioning to the new Maneuver Captains Career Course. The data from the 23 international students enrolled in ACCC were not included in the analysis. The final sample of 95 students (7-11 per small group) used for analysis consisted of 82 captains (CPTs) and 13 first lieutenants (LTs). Two small groups (n = 16) received TLAC training during the course and 9 small groups (n = 79) only engaged in traditional TDGs.

Procedures

The ACCC is conducted in small groups of 10-12 LT's and new CPT's led by a senior CPT or MAJ that serves as the SGI. Most of the course, including all TLAC training, is led by the SGI in small classrooms with laptop computers and all necessary reference materials easily accessible in either digital or hardcopy format. Before the courses began, SGI's were trained on adaptive thinking and how to use TLAC in the classroom by a TLAC developer. Instructors also received lesson plans that included specific information on each vignette and identified the key training objectives (Lussier, Shadrick, & Prevou 2003). The lesson plans included links to additional information needed to facilitate the class discussion. Furthermore, the plans included specific probes instructors could use to elicit additional information from students, thus, prompting the students to think. Additionally, notes concerning the vignette were included with feedback information that could be provided to participants based on the probes instructors used.

The ACCC is divided into eight modules called "volumes" (see Appendix A for descriptions), each of which focuses on a different aspect of command. TLAC training (and the TDGs for the groups that did not receive TLAC training) occurred during Volumes D (*Company/Team Offense*) and E (*Company/Team Defense*). The training program was installed on every student's laptop computer, as well as on the instructor's classroom workstation. The instructor presented the audio/video vignette to the class using a Proxima® display unit. After reviewing a vignette, students were asked to individually list all of their important considerations for the vignette—the key features of the tactical situation. After the students typed their lists using their individual computers, the instructor led a discussion of the vignette to highlight the relevant teaching points related to the vignette. Finally, students were required to compare the

lists of important considerations they initially generated with a list of critical indicators presented on their screen—key tactical considerations—previously generated by a panel of expert tacticians and to score themselves accordingly. They then received on-screen feedback on their performance based on the TLAC themes. The same procedures were used to complete 7-9 vignettes.

Measures

Pre-tests. To determine if there were potentially relevant differences among students before TLAC training occurred, student performance on three measures from Volumes A-C were used as pre-tests. *Operations* was a written test covering the fundamentals of Army operations taken on completion of Volume A. The *MDMP* was a written test on the use of the military decision-making process (MDMP) and task-force level offensive operations taken during Volume B. The *HBCT Ops* was a written test over Heavy Brigade Combat Team (HBCT) operations taken on completion of Volume C.

Post-tests. To determine if transfer occurred, student performance on three measures from Volumes D and E were used as post-tests that covered the production of a company/team OPORD. An OPORD consists of five paragraphs:

- Paragraph 1 (*Situation*) describes enemy forces, friendly forces, terrain, weather, and civil considerations.
- Paragraph 2 (*Mission*) describes the unit's task and purpose.
- Paragraph 3 (*Execution*) describes the commander's intent, the concept of the operation, specific tasks for sub-units and attachments, and combat support information.
- Paragraph 4 (*Service Support*) describes the concepts of logistics support for the mission.
- Paragraph 5 (*Command and Signal*) describes the location of command posts and signal instructions.

Students produced their OPORD's in class on their laptops, printed them out, and briefed them to their SGI's. All OPORD's were scored by a board of SGI's using a standard, objective grading scheme. Three parts of the OPORD's were scored separately and were used as the post-tests. The *OPORD 1&2* consisted of paragraphs 1 and 2. The *OPORD 3* covered OPORD paragraph 3. The *OPORD 4&5* covered OPORD paragraphs 4 and 5.

Analyses

Raw scores on all pre-tests and post-tests were converted to percentage scores for presentation and inferential analyses. Data were analyzed in two ways. First, an overall analysis was done on all 95 U.S. students from ACCC. This compared nine small groups that did not receive TLAC training but did engage in TDGs (the NO TLAC condition) with two small groups that did receive TLAC training (the TLAC condition). In order to control for potential effects of small group instructor, a second analysis was done on two small groups that were led by the same instructor, one without TLAC and one with TLAC. A separate analysis was done on each

pre- and post-test. In addition, the three post-tests were combined to create a composite score by weighting each test by the number of points the test was worth.

Results

An alpha-level of .05 was used for all analyses. Two-tailed tests were used for the pre-tests to determine if there were any differences between the conditions before TLAC training. One-tailed tests were used for the post-tests to examine the specific hypothesis of whether those who received TLAC training performed better than those who did not receive TLAC training. The magnitude of the effect size was estimated using Cohen's *d* and the description of each effect (large, medium, small) used the cutoffs suggested by Cohen (1988).

Overall Analysis Across Instructors

Because of unequal sample sizes between the NO TLAC and TLAC conditions and a lack of homogeneity of variance, Welch's variant of the *t*-test was used in the overall analyses. Percent correct for each condition on the pre-tests are shown in Table 1. Percent correct for each condition on the post-tests are shown in Figure 4.

Pre-tests. Pre-test scores indicated that there were no significant differences between the conditions before TLAC training began, all p's $> .05$. All effect sizes were small, all d's $< .45$.

Table 1

Performance (Percent Correct) on Pre-tests by Training Condition (overall analysis)

	Condition	
Test	NO TLAC M (SE)	TLAC M (SE)
Operations	90.27 (0.75)	91.03 (1.54)
MDMP	87.43 (0.98)	84.25 (1.71)
HBCT Ops	86.06 (1.06)	84.31 (1.29)

Post-tests. Post-test scores indicated that there were significant differences between the groups on each of the measures as well as the composite score. In each instance of a significant difference the condition that had received TLAC training had a higher percentage score than the condition that did not receive TLAC training. For the *OPORD 1&2* test a strong effect of TLAC training was found, t (33.52) = 4.39, $p < .05$, $d = 1.21$. For the *OPORD 3* test, a moderate effect of TLAC training was found t (50.317) = 1.78, $p < .05$, $d = .50$. For the *OPORD 4&5* test, a strong effect of TLAC training was found, t (39.32) = 4.66, $p < .05$, $d = 1.30$. For the composite score, a strong effect of TLAC training was found, t (41.367) = 3.10, $p < .05$, $d = .87$.

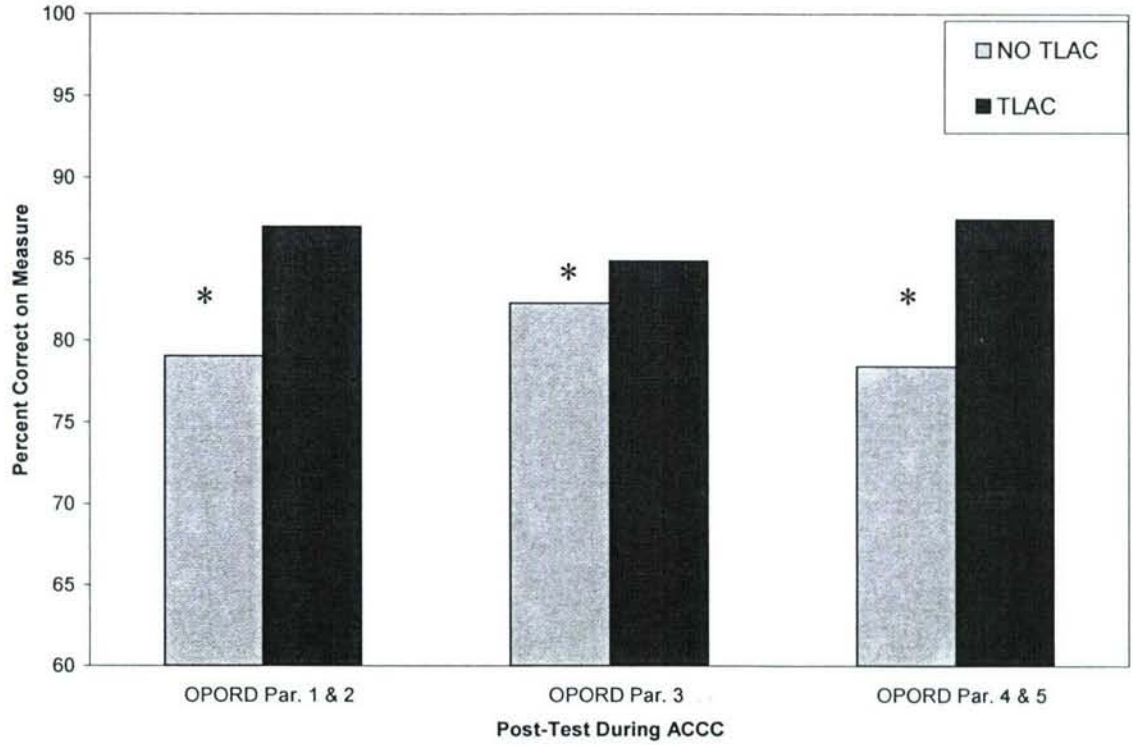

Figure 4. Performance (percent correct) on post-tests by training condition (overall analysis). Note: * indicates significant difference, $p < .05$

Same Instructor Analysis

Percent correct for each condition on the pre-tests are shown in Table 2. Percent correct for each condition on the post-tests are shown in Figure 5.

Pre-tests. Scores on pre-test *HBCT Ops* were not reported for the small groups that did not receive TLAC training. Therefore, only the first two pre-tests were analyzed. Pre-test scores indicated there were no significant differences between the NO TLAC and TLAC conditions before TLAC training began, all p's $> .05$. The effect size for test *Operations* was trivial, $d = .04$. However, the effect size for *MDMP* was large, $d = .94$. This suggests that the TLAC condition actually scored lower on this pre-test than the other condition before the TLAC training was administered.

Table 2

Performance (Percent Correct) on Pre-tests by Training Condition (same instructor)

Test	Condition	
	NO TLAC M (SE)	TLAC M (SE)
Operations	88.13 (3.27)	87.81 (2.40)
MDMP	85.50 (3.28)	79.00 (1.72)

Post-tests. Post-test scores indicated that there were significant differences between the conditions on *OPORD 1&2* and *OPORD 4&5* measures as well as the composite score. In each instance of a significant difference the condition that had received TLAC training had a higher percentage score than the condition that did not receive TLAC training. For the *OPORD 1&2* measure, a strong effect of TLAC training was found, $t\ (14) = 6.10$, $p < .05$, $d = 3.26$. For the *OPORD 3* measure, a small effect of TLAC training was found although it was not significant, $t\ (14) = 0.84$, $p > .05$, $d = .44$. For the *OPORD 3&4* measure, a strong effect of TLAC training was found, $t\ (14) = 2.71$, $p < .05$, $d = 1.45$. For the composite score, a strong effect of TLAC training was found, $t\ (14) = 2.02$, $p < .05$, $d = 1.08$.

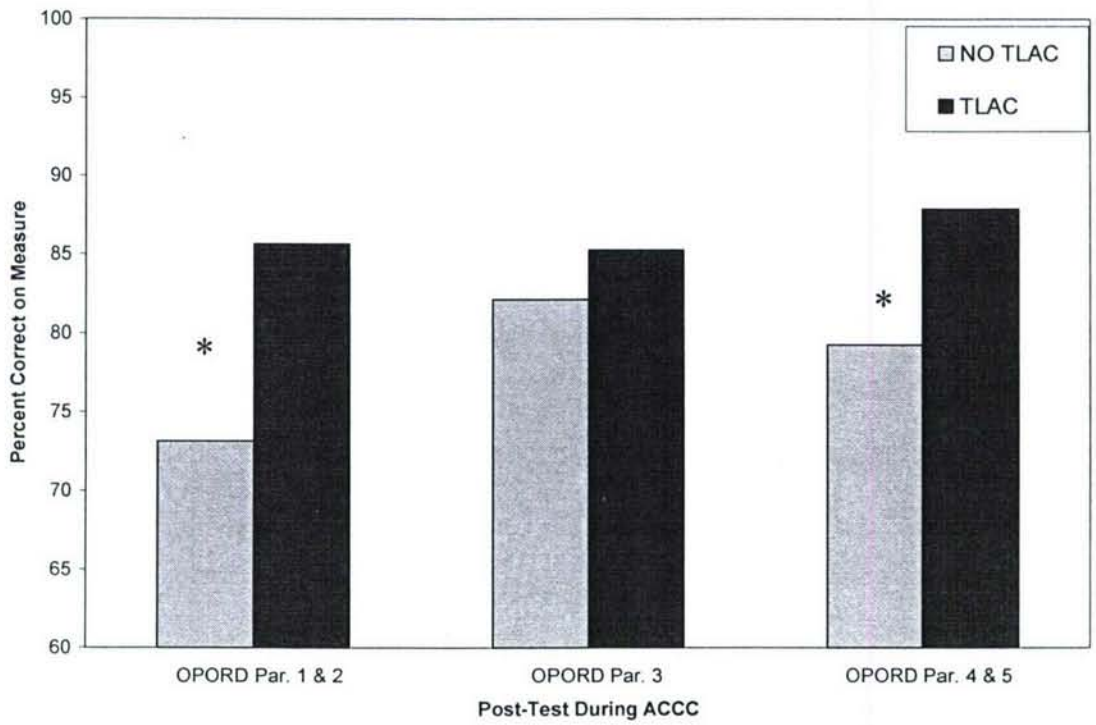

Figure 5. Performance (percent correct) on post-tests by training condition (same instructor). Note: * indicates significant difference, $p < .05$

Discussion

The purpose of the present research was to determine if the cognitive behaviors trained in TLAC transfer to other important battle command skills. Although there was no difference in performance before TLAC training began, students who received TLAC training consistently produced significantly better OPORD paragraphs than did those who did not receive TLAC training, but only engaged in TDGs. The TLAC training had a large effect on students' ability to produce paragraphs 1 (*Situation*), 2 (*Mission*), 4 (*Service Support*), and 5 (*Command and Signal*). The TLAC training had a smaller effect on students' ability to produce paragraph 3 (*Execution*). Overall, these results provide strong evidence that the cognitive behaviors trained in TLAC do transfer to other important tactical leader tasks.

Although the TLAC versus OPORD tasks appear quite different, the cognitive behaviors underlying them are quite similar. That is, while the two tasks have low surface similarity, they have high structural similarity. The TLAC deliberately trains some of the cognitive behaviors (the Themes of Battlefield Thinking) that are useful in both tasks. A close look at the relationship between the TLAC themes and the OPORD paragraphs demonstrate a high degree of overlap. Table 3 illustrates which OPORD paragraphs would benefit from each of the themes taught during TLAC. For example, *Keep a Focus on the Mission and Higher's Intent* is an important consideration in writing paragraph 2 (Mission), in which the commander must communicate the mission received from higher. This theme would also be critical in paragraph 3 (Execution), in which the commander must "...ensure that [his] concept of operations is consistent with [his] intent and that of the next two higher commanders" (FM 5-0). *Visualize the Battlefield* is essential in paragraph 1 (Situation), paragraph 4 (Service Support), and paragraph 5 (Command and Signal). Indeed, each TLAC theme relates to at least two paragraphs in an OPORD. Because of this similarity in the cognitive behaviors between the two tasks, students are able to transfer the themes learned in TLAC to the task of writing an OPORD.

Table 3

Relationship between TLAC Themes and OPORD Paragraphs

TLAC Theme	OPORD Paragraph(s)
Keep a Focus on the Mission and Higher's Intent	2, 3
Model a Thinking Enemy	1, 2, 3
Consider Effects of Terrain	1, 3, 5
Use All Assets Available	2, 3, 4
Consider Timing	2, 3, 4
See the Big Picture	1, 3, 4
Visualize the Battlefield	1, 3, 4, 5
Consider Contingencies and Remain Flexible	3, 5

A straightforward prediction from the account outlined above would be that those parts of the OPORD that match up most with the themes from TLAC, should show the highest level of transfer. That is, paragraph 3, which matched with all of the TLAC themes, should have shown the highest level of transfer. Interestingly, paragraph 3 actually showed the lowest level of transfer. However, this finding likely reflects the manner in which the course is taught. The SGI's report that they spend most of their time on paragraph 3 when they teach students how to develop an OPORD. This view is further supported by a one-way, within-subjects analysis of variance on the post-test performance for those students that did not receive TLAC training. This analysis indicates that students perform significantly better on paragraph 3 than on the other paragraphs of an OPORD, $F(2, 122) = 6.39$, $MSE = 36.78$, $p < .05$ (see Figure 4 for the percentages). This pattern is not found for those students that received TLAC training. This suggests that in ACCC, TLAC may 'fill in the gaps' of SGI direct instruction on paragraphs 1, 2, 4, and 5. Further, TLAC also improved performance for that part of the OPORD upon which SGIs spend most of their instructional time.

While the finding of positive transfer to other parts of the ACCC is important, the critical question is whether TLAC training positively transfers to battlefield command. A direct empirical test of this (e.g., a comparison of TLAC-trained and untrained commanders on their performance during deployment to OIF/OEF) would be very difficult to perform. Indirect tests are more plausible. One approach would be to determine if TLAC improves war-gaming performance. Although empirical verification is needed, SGI's and Observer/Controllers from ACCC have stated that TLAC training results in superior war-gaming exercise performance. In addition, ARI is planning to interview Army National Guard commanders (who receive TLAC training before deployment to OIF/OEF) after they have returned to determine if they believe that TLAC helped prepare them for their deployment.

One important factor that might dictate the degree to which TLAC training transfers to actual battlefield performance is the degree to which the use of the TLAC themes has become automatic. On the battlefield, there is little time to consciously reflect upon the themes to make an adaptive decision; rather, automatic retrieval and use of the themes would be optimal. It is unlikely that the TLAC themes have become fully automatic in ACCC students after only a handful of vignettes. However, deliberate practice over many trials has been shown to lead to automaticity in other cognitive domains, such as chess (e.g., Charness, Tuffiash, Krampe, Reingold, & Vasyukova, 2005). This suggests that an expansion of the TLAC methodology in a format that could be used throughout an officer's career could develop truly automatic, "intuitive" adaptive thinking. To this end, an instructorless version of TLAC called "Captains in Command" has been developed and will soon be available to Soldiers on the Mounted ManeuverNet–Battle Command Knowledge System or other Army-approved web portal. The web-version of TLAC allows for training to occur anywhere a Soldier can access the web and for new vignettes to be easily added for further training. The combination of anywhere, anytime training with an ever-expanding set of vignettes provides the possibility of training truly automatic, adaptive thinking in current and future Army commanders.

Conclusions

The finding of positive transfer from TLAC to other battle command tasks supports the continued use of the TLAC training program. Further, the results of this research illustrate the benefit of using deliberate training methods to supplement traditional institutional methods of instruction. Ongoing ARI research is exploring how the deliberate training methods discussed here can be applied to train other complex, cognitive tasks such as battlefield visualization. In addition, ARI is developing other innovative ways to improve battle command skills, such as providing coaching and feedback using low-cost, 3-D animations and improving methods for measuring cognitive task performance.

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Appendix A

Objectives of ACCC Volumes

VOL A-B (*Fundamentals and Task Force (TF) MDMP*): As a TF Assistant S3, apply the seven steps of MDMP for TF offensive operations. Using the Battle Command model from FM 5-0 (Visualize, Describe, Direct):

Analyze the environment and the enemy using the four steps of Intelligence Preparation of the Battlefield, and describe the enemy using the Observation, Indirect fire, Direct fire. Obstacles, Chemical, Air, Reserve, and Electronic model
Develop a nested mission statement
Develop commander's intent
Develop and communicate a concept of operations paragraph

VOL C (*Brigade Combat Team (BCT) Offense*): As a Heavy Brigade Combat Team (HBCT) staff officer, develop plans for shaping, decisive, and sustaining HBCT full spectrum offensive operations incorporating Joint capabilities and Effects Based Operations. Demonstrate competence as a HBCT staff officer during the execution of a constructive Command Post Exercise (CPX).

VOL D (*Company/Team (CO/TM) Offense*): As a tank/mech company commander, develop executable offensive plans. Demonstrate competence in planning, preparing and executing CO/TM offensive operations in a live or virtual environment. Apply the eight principles of Direct Fire Planning in offensive operations.

VOL E (*CO/TM Defense*): As a tank/mech company commander, develop executable defensive plans. Demonstrate competence in planning, preparing and executing CO/TM defensive operations in a live or virtual environment. Apply the seven steps of Engagement Area Development in defensive operations.

VOL F (*Urban Operations*): As a company commander, develop executable plans for full spectrum urban operations. Analyze the environment and enemy in an urban environment. Develop company plans for CO/TM Stability Operations and Support Operations in an urban environment. Apply the seven phases of a deliberate attack in an urban area.

VOL G (*Intelligence, Surveillance, and Reconnaissance (ISR) and Security Operations*): As a Squadron Assistant S3, develop executable plans for a reconnaissance, surveillance, and target acquisition Squadron operating as part of a Stryker BCT. Demonstrate competence in linking ISR plans to filling voids in information, answering Priority Intelligence Requirements, and enabling targeting. As a Combined Arms Battalion (CAB) Assistant S3, develop executable plans for a Moving Flank Guard security operation. Apply the five fundamentals of security operations. Demonstrate competence as a CAB staff officer or tank/mech company commander in executing CAB and CO/TM moving flank guard operations in a constructive CPX.

VOL H (*Taking Command*): As an ACCC graduate, describe the principals of company training management, Command Supply Discipline Program, Army maintenance policy, Uniform Code of Military Justice, counseling, leader development, team building, and taking charge of and commanding company/troop level organizations. Develop a command philosophy.